Interferometric Detection of Freeze-Thaw Displacements of Alaskan Permafrost Using ERS-1

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The possibility of making large scale (50 km) measurements of motions of the earth's surface with high resolution (1 O m) and very high accuracy (1 cm) from multipass SAR interferometry was recently established [1]. Other experiments [2, 3] have confirmed the viability and usefulness of the method, some dramatically [4, 5]. Work is underway in the present study to measure displacements from the freeze-thaw cycles in Alaskan permafrost. The ground is known to move significantly in these cycles, and providing that freezing does not cause image decorrelation, it should be possible to measure both ground swelling and subsidence.

We have obtained data of multiple passes of ERS-1 over the Toolik Lake region of northern Alaska of suitable quality for interferometry. 'The data were processed at the Alaska SAR Facility into images. From these data, pairwise image registration offsets were measured as previously described [6]. Single interferograrns were formed after oversampling the data by a factor of two. Spectral shift filtering [7] to reduce baseline decorrelation was applied where the baseline was large. Phase unwrapping was performed, and the multipass baselines were estimated from the images using both orbit ephemerides and scene tic points. Convergence of the orbits was modelled in the baseline estimation by a linear dependence of the baseline on the along track position. The phases were scaled by the baseline ratio, and double-difference interferograms (DDI) was formed.

The data were acquired over a 2 month period in the autumn of 1991; evidence of transitions from thaw to freeze should be present in the DDIs phase measurements. Indeed, the DDIs examined so far show significant phase changes over the period of the observation.

References

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